Journal of the Royal Society of Western Australia, **71** (4), 1989, 95-96

Terrestrial invertebrate fauna

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Introduction

The interactions between certain plant and invertebrate species in *Banksia* woodlands have been reviewed by Byron Lamont in this Symposium. This paper reviews what little information is known about the invertebrate communities of this plant formation. It is arranged in the following way. First, some thoughts on the species composition of invertebrate communities in *Banksia* woodlands are presented. This is then followed by a review of the effects of disturbance on certain components of the invertebrate fauna. Next, the few remaining invertebrate community studies which have been carried out in this vegetation formation are reviewed and, finally, a prognosis for the conservation of *Banksia* woodland invertebrates is presented.

Invertebrate communities in *Banksia* woodland

In simplistic terms, the *Banksia* woodlands consist of small trees of about 6-8 m under which there is a well developed sclerophyll shrub understorey. This formation tends to be bounded on the western edge by tuart (*Eucalyptus gomphocephala*) open-forest and to the east by jarrah (*E. marginata*)-marri (*E. calophylla*) open forest. Both of these formations have a well developed tree stratum of at least 25 m height and, like the woodlands, the latter of the two formations has a well developed shrub understorey. The *Banksia* woodland therefore differs from the adjoining formations in lacking a taller *Eucalyptus* tree stratum, and from the tuart open-forest in possessing a well developed shrub layer. The majority of the woodlands occur on the older Bassendean dune system which, in comparison with the adjoining soils, has soil of poorer nutrient status. Taking these factors into account, it is likely that the invertebrate community of the woodlands may differ from that of the adjoining plant formations.

There are few published accounts of the composition of individual invertebrate faunas in *Banksia* woodland and nearby plant formations. Abbott (1982) surveyed earthworm distribution in the Perth metropolitan area. He found seven native species, of which only two were confined to undisturbed habitat, principally woodland or swampland. The other species were also found in habitats which had been modified by humans. In reviewing the literature on earthworm distribution on the part of the Darling plateau close to Perth, Abbott (1982) found seven additional species which were absent from the metropolitan coastal plain area. It therefore appears that the coastal plain earthworm fauna differs substantially from that of the Darling plateau and this may be associated with differences in climate, soil type or other factors.

Rossbach & Majer (1983) surveyed the composition of the ant fauna in two coast-to-Darling Range transects which ran through the various plant formations. They found that while many species occurred in a range of plant formations, some were confined to one type such as the *Banksia* woodland. An ordination of the various sites in terms of their ant species composition indicated that the jarrah-*Banksia* woodland sites had a characteristic ant fauna, which was allied to that of the tuart open-forest and the *Banksia*-sheoak (*Allocasuarina fraseriana*)-prickly bark (*E. todtiana*) woodland. The ant fauna of the woodland differed from that of the coastal scrub and the Darling plateau open-forest. On the basis of this rather limited information on invertebrate species composition in various plant formations, it seems likely that the overall invertebrate fauna of *Banksia* woodland is to some extent distinctive, although many species would probably be shared with adjacent plant formations.

Although not peculiar to the *Banksia* woodlands, the invertebrate fauna of this region also exhibits a strong seasonality. Koch & Majer (1980) and Majer & Koch (1982) compared the seasonality of surface-active invertebrates at Reabold Hill in tuart-jarrah woodland, where some *Banksia* spp. were present, with that of jarrah open-forest at Dwellingup and Manjimup.

Their data indicated that the various functional groups exhibited seasonal patterns which differed between the woodland and forests in their time or length of activity. This is well illustrated by the variation in duration of activity of slaters (Isopoda), a group which is involved in the decomposition of litter. The duration of activity increased progressively from Reabold Hill to Dwellingup to Manjimup, being restricted to the wetter months at Reabold Hill and Dwellingup, but active throughout the year at the southern-most site. This trend appears to be related to the duration of rainfall, which is least at the Perth site.

Effects of disturbance

John Beard has already pointed out that some 61% of *Banksia* woodland is now alienated land where the original vegetation has largely been cleared. A number of studies have looked at the effect of habitat modification on selected invertebrate groups in what was formerly *Banksia* woodland.

Springett (1976a) looked at the species richness and population density of soil microarthropods in three *Pinus pinaster* stands at Gnangara and compared this with densities in the native woodland of the area. Whilst the species richness of selected microarthropod taxa was generally halved by replacing the woodland with pines, the density of microarthropods in the pines was in the same range as that of the woodland. Accompanying decomposition studies indicated that the less species-rich soil fauna of the pine plots was unable to decompose pine or sclerophyll litter as fast as the fauna of the woodland.

Another fate of *Banksia* woodland is urbanization. Majer & Brown (1986) surveyed the ant fauna in 33 Perth gardens, most of which were situated in former woodlands. They found that

ant species richness was significantly reduced in gardens when compared to native vegetation. By quantifying the makeup and management practices of each garden and correlating these parameters with the ant fauna, they found that the variety of the ant fauna was enhanced by the length of time the garden had been established, by increasing the size of the garden and by providing a thick leaf litter and ground cover. Gardens where pesticides were used, where tall shrubs were dense or where management practices such as watering were intense, had a depauperate ant fauna. In view of the fact that the variety of ants tends to reflect that of other invertebrate groups, these conclusions might also apply to other components of the invertebrate fauna.

The remaining *Banksia* woodlands are subject to a number of pressures. One is the invasion of woodland by veldt grass (*Ehrharta calycina*). Barendse *et al.* (1981) surveyed the spider fauna of King's Park and found that areas colonized by veldt grass harboured a spider fauna of low abundance and species richness. Presumably this is either because the veldt grass occupies the feeding space which is normally used by spiders or because it harbours less invertebrate prey items than the native vegetation.

A widespread influence on *Banksia* woodlands is burning so, not surprisingly, a number of studies have been performed on this phenomenon.

Springett (1971, 1976b) looked at the effect of fire on soil fauna in woodland at Gnangara which had been replaced by pines. Discussion of this study is outside the scope of this paper. Around the same period Bornemissza (1969) described post-fire changes in the soil fauna within the woodlands of King's Park. Although this was an extensive long-term study, only an abstract of the results was ever published. It concludes that changes in numbers and species composition could be detected up to 5 years after a fire.

Whelan, Langedyk & Ashby (1980) and Bamford (1986) looked at the effects of burning on surface-active invertebrates. Pitfall trapping was employed in both of these studies. The former study, which was performed near Jandakot, found that invertebrate catch increased in the immediate post-fire period. Although this was in part an artifact of the sampling method, it does highlight the ability of a large component of the invertebrate fauna to survive a fire. Concurrent hand collections performed by Whelan *et al.* (*op cit*) revealed that many animals survived the fire by congregating in the crowns of *Macrozamia riedlei* and *Xanthorrhoea preissii* or under fallen logs.

Bamford's (1986) study was performed at Mooliabeenee and looked at both short-term (< 1 year) and long-term (1-22 years) impacts of fire. His monthly data collected within a year of burning indicated that spring burning had a greater impact on the 'ant' and 'other invertebrate' categories than did autumn burning. In the long-term, ant numbers declined to lower levels after reaching a peak one year after burning, while 'other invertebrates' progressively increased with time after fire as the litter layer built up. A more restricted program of sampling the understorey foliage invertebrates produced higher numbers 6 years after burning than those obtained after 23 years. This trend could be associated with the stimulation, and later the senescence, of vegetation after fire.

The relationship between invertebrates and post-fire plant succession was examined in more detail by Whelan & Main (1979). This work was carried out in small and large area burns near Jandakot. Whilst grasshopper invasion was rapid in the smaller burnt areas, grasshoppers were absent from the larger areas for 1-2 years after fire. This absence of grazing grasshoppers allowed escape of seedlings from predation, while in the smaller areas the susceptibility of seedlings to grazing was influenced by the relative palatability of species.

Other studies

Davidge's (1979) study of the herpetological community of a *Banksia* woodland near Jandakot included an analysis of the diets of the various frogs and lizards. Analysis of gut contents revealed that with the exception of the frog *Myobatrachus gouldii*, a termite specialist, all species were opportunistic feeders which fed on a wide range of prey items including vertebrates, plant material and sixteen categories of invertebrates.

The only other published community study from *Banksia* woodland which I am aware of is Bornemissza's (1957) analysis of arthropod succession in carrion. This study, which was carried out in King's Park, identified five different stages of carcass decomposition and these were correlated with the animal communities present in the decomposing tissue. Bornemissza also looked at the reinvasion of the carrion zone by soil arthropods and found that this was not complete after one year.

Conservation of Banksia woodland invertebrates

This review of the literature on terrestrial invertebrates has indicated how community composition can be altered by urbanization, veldt grass invasion, the frequency and season of burning, as well as by clearing of the original woodland for some new land use. Therefore, if the conservation of invertebrates in *Banksia* woodlands is to be catered for, we need to consider if, when, and how frequently to burn such areas and we also need more information on the impact of weed invasion on the terrestrial invertebrate fauna.

The fragmentation of the remaining woodlands by agriculture, roads, urbanization and other land uses is also reason for concern. However, unlike vertebrates, the conservation of relict areas of only a few hectares in size can be adequate to preserve almost all the invertebrate species of the community (Key 1978). This, of course, assumes that the relict areas are managed in an appropriate way to maintain environmental quality.

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